An examination of the knowledge barriers in participatory design and the prospects for embedded research

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ABSTRACT
Participatory design has the moral and pragmatic tenet of including those who will be most affected by a design into the design process. However, good participation is hard to achieve and results linking project success and degree of participation are inconsistent. Through three case studies examining some of the challenges that different properties of knowledge – novelty, difference, dependence – can impose on the participatory endeavour we examine some of the consequences to the participatory process of failing to bridge across knowledge boundaries – syntactic, semantic, and pragmatic. One pragmatic consequence, disrupting the user's feeling of *involvement* to the project, has been suggested as a possible explanation for the inconsistent results linking participation and project success. To aid in addressing these issues a new form of participatory research, called embedded research, is proposed and examined within the framework of the case studies and knowledge framework with a call for future research into its possibilities.

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Participatory design, embedded research, knowledge boundaries, participation, involvement

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H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Participatory Design is a philosophy that in the end comes down to ethics and power sharing. It is an ethical and pragmatic stance that commits the designer to engage from the outset with those people affected by a design outcome in order to prioritize their agency and quality of experience. It allows people to 'engage in meaningful and purposive adaption and change to their daily environment' (Sanoff, 2007). In other words, people who will be affect by an outcome should have a say in what that outcome will be, and those who will have to engage in the adoption of a new outcome should be likewise engaged in the process that leads to the outcome (Carroll & Rosson, 2007).

It is believed that participation is a necessary condition of a successful project outcome (Ives & Olson, 1984). However, Kappelman (Kappelman & McLean, 1992) has demonstrated that there are many case-studies where results were inconsistent in demonstrating a strong link for reasons other than poor methodology. He and others (Barki & Hartwick, 1989) have suggested that these inconsistent results may be the effect of a practical problem whereby the *action* of participation is upheld but the genuine *involvement* of the user is not engaged (Barki & Hartwick, 1989; Kappelman & McLean, 1992).

Moreover Brereton and Buur point out that in this era it is often hard to achieve high levels of participatory engagement along the following dimensions outlined by Tom Erickson at the 1994 Participatory Design Conference (inspired by Kuhn & Winograd, 1996) that were achievable in the:

1. Directness of interaction with the designers
2. Length of involvement with the design process
3. Scope of participation in the overall system being designed
4. Degree of control over the design decisions.

Instead new formats of participation in an era of ubiquitous computing and a much more mobile workforce can be characterized by their sensitivity towards new types of network relations among people, the diverse motivations of people to participate, the subtle balance of values and benefits involved in collaborative endeavours, and the inherent power relations between participants.

Thus, we will explore the three case studies described by Brereton and Buur (2008) within the framework of engagement (Kappelman & McLean, 1992) and the management theory involving the transference, translation, and transformation as proposed by Carlile (2004)[1]. We hope to make the case for further research

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[1] Carlile's 2004 paper explores a case study in which the framework described is used to illustrate its value in connecting different expertise in pursuit of a successful

into a new participatory action research method, called embedded research, which might provide a new practical means of furthering the participatory design philosophy.

This paper will start with a quick summary of the participatory design projects explored in Brereton and Buur's paper. From these examples, Carlile's framework for understanding knowledge dependencies will be explained, starting with properties of knowledge (novelty, difference, and dependency). Following this are the consequences that arise by failing to bridge knowledge boundaries (syntactic, semantic, pragmatic). The pragmatic boundary has consequences on the set of behaviours involved with *engagement* (i.e., participation and involvement) as described by Kappelman. The concluding discussion will describe the nature of embedded research and explore how all of the presented concepts fit together, thus outlining the need for further studies into this new technique.

CASE STUDIES

Brereton and Buur discuss the motivation behind three case studies in which the respective design teams chose to situate their projects within the participatory design philosophy. From this, two fundamental and related questions can be posed. The first is *who* benefits from participation (Beck, 2004; Shapiro, 2005) and the second is what is the *relationship* between the target user, the design project, and the design team? While the complexities and situational uniqueness of the user's relationship to the project outcome are what require the use of participatory methods to yield meaningful results, the nature of the relationship between end user and design team (e.g. trust, etc.) still remains unexplored. We propose that it is through this relationship – that of user to designer – where potential communication boundaries might arise.

CASE 1: NNUB

Nnub is a design project in the community of Moggill, Qld Australia that is using a located technological interface to engage the community within the design problem. The design problem, per se, is one of investigating 'opportunities for community communication' (Brereton & Buur, 2008). 'This project aims to grow the fabric of communication infrastructure that supports the general public' (p.104). However, use of a localized digital notice board within the community is not without its problems.

One of these problems is trying to understand the complex network of people who all have their different political, practical, and private relationships that create the fabric of the community. Each member of the community has their perspective, daily routines, and related expertise in use of digital technology. It cannot be assumed that there is a base level expertise, and thus the introduction of the digital notice board embodies one of the fundamental properties of knowledge: novelty.

"*Novelty* [emphasis added] underscores the participatory and relation nature of what an actor needs to share and assess when all is not known" (Carlile, 2004 p. 577). Due to the complex nature of the community in which the digital display is placed there are certain parameters which the designers *cannot* know, such as how much each community member knows about digital displays, how users view the motivations of the designers which brought forth the project, and if users can see the possibilities that the proposal has on enhancing their own daily lives.

As novelty increases, i.e. as that which is not known increases, other properties of knowledge and their related boundaries emerge.

CASE 2: MOVEMENT SOFTWARE

This project is about creating input software that allows dentists, whose hands are often occupied with dental instruments, to update a patient's dental record using gestures and speech rather than typing on a keyboard. This would enable the dentists to update the patient's records while explaining the situation to the patient, saving the dentist time.

Here, the design team must engage the dentists in their localized context of practice. The dentist and the design team have different sets of expertise. The designer has experience in designing and understands how to program software in order to create the inputs required, however, only the dentist knows the parameters such as how they can move and what types of information is needed to be input, etc.

The property of knowledge associated in this case is that of *difference*. Carlile relates this to type and/or amount of knowledge between two people. This includes novice-expert distinctions or differences in domain specific knowledge. In this example the difference is between the domain specific knowledge of how to design and program software and the constraints of the dentists.

CASE 3: MASS CUSTOMIZATION

This project underlines how the different actors involved in a project (e.g. manufacturer, end user, design team, etc.) have different motivations and networks of relations. Brereton and Buur (2008) explore the design and research involved in turning mass produced commercial refrigeration units into optimal-customization units. To the manufacturer high customization means high prices. To the store owner it means a more flexible system, and to the technician hired to install the units the simpler the unit the faster the job.

In this example, the question of *who* will benefit from the design becomes quite salient. The motivations of the different clients all differ, and it is the design team which must prioritize which driving force, including their own

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project outcome. By understanding the dependencies of knowledge, and the political mismatches which can arise it is proposed that one can avoid the pitfalls seen in many teams. While participatory design techniques are about involving people *not* on an in-house design team the issues involving the transfer of knowledge *to* the design team remain salient.

responsibility to internal project deadlines, will lead to the most successful outcome.

This case study exemplifies the knowledge property called *dependence*. Dependence is "defined by Litwak and Hylton (1962) as a condition where two entities must take each other into account if they are to meet their goals" (Carlile, 2004 p.556). Carlile focuses on three dependencies commonly accepted in literature as pooled, sequential, and reciprocal (Thompson, 1967).

In the case study of refrigeration it is clear that the designers cannot meet their goals if they discard one of the stake holders. If the design is too cumbersome to fit into stores, if the cost of installation is too high, or the unit cost per fridge is too great the product simply won't sell and the designers will have failed to meet their task.

BOUNDARIES OF COMMUNICATION

Similarly to the three types of knowledge described above in context with the case studies, there are three types of boundaries that can sometimes serve as barriers to communication. These include the syntactic, semantic, and pragmatic boundaries. These boundaries exist when different types of expertise come together in a design team (Carlile, 2004) or through any collaboration of different expertise including user-centred design techniques (Gasson, 1999). Participants are often unaware of these boundaries and this can sometimes lead to the emergence of barriers that block communication.

The *syntactic* boundary occurs when the common lexicon fails sufficiently to specify the differences of the knowledge and/or the consequences of the dependencies. This boundary can be thought of as an inability to share common knowledge. When this boundary is not overcome knowledge has failed to be *transferred*. In the case of the speech and movement recognition software for dentists, the common knowledge that must be transferred from the context to the designer include information such as how speech and gesture are used in the context of all the specific dental instruments, hand grips, etc. Failure to consider this type of knowledge will result in an unusable product.

The *semantic* boundary occurs when meanings between common words are not shared. For example, the concept of 'user participation' is a phrase shared by both community designers and traditional industrial designers. Community designers view participation as a means towards democracy whereas in traditional industrial design participation of users can have the focus simply of making more saleable items (Brereton & Buur, 2008). In the case of Nnub the term 'digital notice board' has layman connotations. Thus, as a result the initial use of the board was to substitute paper for digital flyers, but which contained the same nature of content (e.g. selling of cupcakes, notices of policies, school closures, etc.). As the project is growing and new interactive opportunities are created (e.g., scribbles) the nuances of the term 'digital notice board' are changing. Ongoing research into the community's changing understanding of the term 'digital notice board' hopes to yield design iteration opportunities which further encourage its use.

Finally the *pragmatic* boundary, also known as the political boundary, exists when differences in stake cause costs to the actors involved. In other words when different pressures pull the project in different directions priorities must be made. When multiple actors are involved, all of whom have their own individual priorities, this can cause problems. Failure at this boundary can occur between different members of a design team (e.g.Carlile, 2004) or between the design team and the user participants (e.g. Gasson, 1999).

Gasson describes a case study where new software to aid bankers was being developed. In this case the design team engaged bankers in order to gain their insight into what the software might need. However, as the project progressed, the designers began to feel that the inability of the bankers to express what they needed in (software design) concrete terms was keeping them from reaching their internal project deadlines, such as progress reports for their sponsors. In the end, the political climate of the project soured to the point where the users, while still *participating*, were so marginalized that they were no longer *involved*. A breakdown at the pragmatic boundary can result in a breakdown of *user engagement*.

ENGAGEMENT

Kappelman and McLean (1992) define engagement as consisting of two constructs: that of *participation* and that of *involvement*. The authors demonstrate how participation, which refers to the observable actions undertaken by the users, is different and separate from involvement, which refers to the psychological state of the user towards the target whereby the user finds the target both important and personally relevant (Barki & Hartwick, 1989; Kappelman & McLean, 1992). The article demonstrates that participation is not a sufficient condition for project success as was commonly accepted in the literature (e.g. Ives & Olson, 1984).

On the other hand high user involvement will usually polarize users' perceptions about a project, resulting in either high levels of satisfaction or high levels of dissatisfaction (Barki & Hartwick, 1989). This polarization can be influenced by such things as the level of participation in the design process, the quality of the project, etc.

This is where the concept of *embedded research* becomes of great interest. (Brereton, 2009)

EMBEDDED RESEARCH

Embedded research refers to the quality of a designer being naturally integrated into the fabric of community for which the designs are being produced by the function of actually living there (Brereton, 2009 p.103). Belonging to a community involves three types of relationships. These relationships involve belonging to: friendship groups, interest organizations, and implicit groups (p.110). Each type of group requires the negotiation of different barriers.

Friendships are private and informal and involve negotiating a *bonding* barrier. Interest groups require the decision to participate involving negotiating an

engagement barrier. Implicit groups are groups one automatically belongs to by engaging in natural behaviour (e.g., sending children to a local school). This last group, which is most relevant to the thesis, involves negotiating an *awareness* barrier.

There are two immediate benefits to this approach. The first is that the team member has the shared expertise of the target user (a bond, genuine engagement, and natural awareness of the community) as well as the expertise of one of the designers on the team. Thus, the syntactic and semantic barriers are greatly reduced between the design team and the end user (this is not to say that they disappear completely, and they might still exist between design team members as normal). The second benefit is that the pragmatic barrier in having to choose between internal workings and relevance to the user become lessened.

In the Nnub project, the first case study explored by Brereton and Burr, one of the members of the design team is also a member of the Moggill community. This has enabled the design team to gradually bridge the communication barriers through iterative and simple design prototypes which are based on the embedded designers observations and more importantly genuine interactions with other members of the community.

In this way, the non-obvious expertise of the users in their daily lives can be transferred to the design team in non-explicit terms. This is because the embedded designer has the expertise to communicate with the design team and that particular community because she is also a genuine member of the community. She is involved at all three levels of community (friendship, interest groups, and implicit groups) and thus has a greater scope of perspective than other members of the design team.

Further, she has the expertise to communicate with the design team without the added syntactic or semantic barriers. Since the embedded researcher's stake in the community is as genuine as it is to the processes involved in the project, the pragmatic barriers--should they arise--do not automatically favour the project deadlines over its relevance to the community.

SUMMARY

The above listed case studies demonstrate how expertise and barriers to communication can hinder the successful outcome of a project by damaging the user's perception of the project, the relevance of the project to the user, or by hindering the design process.

Embedded research creates a situation where the objectives and expertise of the design team are aligned with the community, thus reducing the gaps in communication which can cause a project to fail. Limitations of embedded research include the risk of ignoring other community perspectives in favour of the embedded researchers, creating boundary failures from overconfidence, etc. For the technique to flourish it needs future research investigating antecedent qualities such as the role of genuine interaction.

Embedded research is clearly only possible where the researcher can be a legitimate embedded participant, whether full or peripheral. Where this is not possible, the examination of knowledge boundaries indicates the areas of communication that need consideration.

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